"Magnetic Properties of Pure Iron." By FRANCIS LYDALL and ALFRED W. S. POCKLINGTON. Communicated by J. HOPKINSON, F.R.S. Received May 4,—Read June 16, 1892.

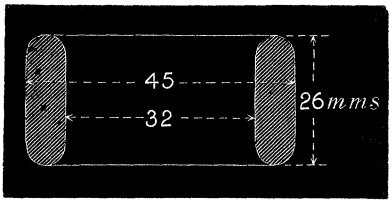
The following results were obtained at King's College, Strand, for a specimen of very pure iron. The experiments were made under the direction of Dr. Hopkinson. The sample was supplied to him by Sir Frederick Abel, K.C.B., F.R.S., to whom it was sent by Colonel Dyer, of the Elswick Works. It is of almost pure iron, and the substances other than iron are stated to be:—

Carbon.	Silicon.	Phosphorus.	Sulphur.	Manganese.
Trace.	Trace.	None.	0·013	0·1

The method of experiment is the same as that described in Dr. Hopkinson's paper before this Society on the "Magnetisation of Iron at High Temperatures," viz., taking a curve of induction at the temperature of the atmosphere, and then at increasing temperatures until the critical point is reached. The temperatures, as in his paper, are calculated from the resistances of the secondary winding, the increase of resistance per 1° C. being assumed to be 0·00388 of the resistance at 20° C. In brackets are also given the temperatures calculated by Benoit's formula—

$$\text{Resistance at } t^\circ \text{ C.} = \text{resistance at } 0^\circ \text{ C.} \{1 + 0{\cdot}00367t + 0{\cdot}000000587t^2\}.$$*

The dimensions of the iron ring are—

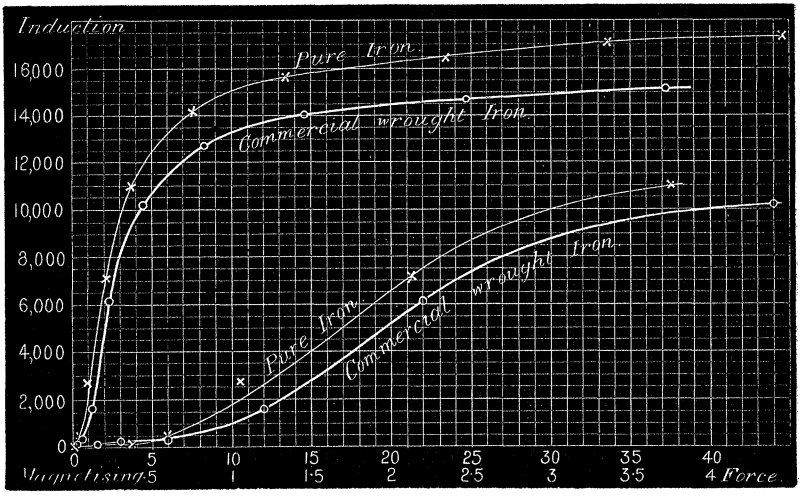


as in the earlier experiments.

Fig. 1 gives the curve of induction taken at 10°·5 C. compared with the sample of wrought iron of Dr. Hopkinson's paper, just referred to, taken at 8°·5 C. It shows the very high induction developed in the pure specimen for a moderate magnetising force, and also the small amount of hysteresis. The following are the actual values of induction, B, and magnetising force, H:—

* Everett's 'C.G.S. Units and Physical Constants,' p. 160.

Fig. 1.



Resistance of secondary = 0·75 ohm. Temperature, 10°·5 C. (pure specimen, marked ×).

B...	34	118	467	2700	7060	10,980	14,160	15,590	16,570	17,120	17,440
H...	0·15	0·38	0·6	1·06	2·11	3·77	7·48	13·36	23·25	33·65	44·66

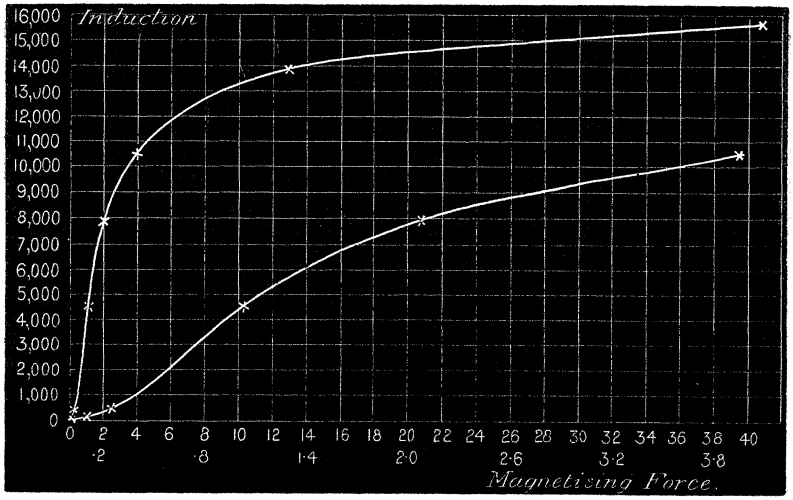
Temperature, 8°·5 C. (ordinary specimen, marked ○).

B.....	39·5	116	329	1560	6041	10,144	12,633	14,059	14,702	15,149
H.....	0·15	0·3	0·6	1·2	2·2	4·4	8·2	14·7	24·7	37·2

Figs, 2, 3, 4, and 5 give the curves taken at the following temperatures, as calculated from the secondary resistances—658° (676°), 727° (738°), 770° (780°), 855° (857°).

The values for these curves are as follows :—

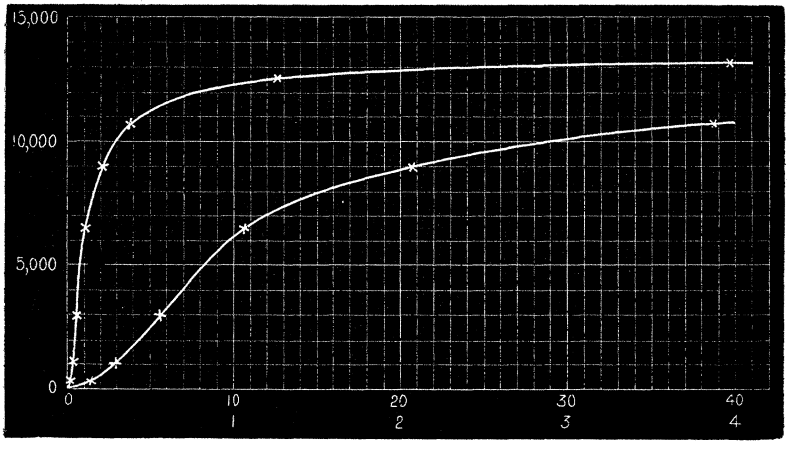
Fig. 2.



Secondary resistance = 2·706 ohms. Temperature, 658° C. (676°).

B.....	103·37	360	4453	7899	10,556	13,836	15,640
H.....	0·09	0·25	1·02	2·08	3·97	12·96	40·92

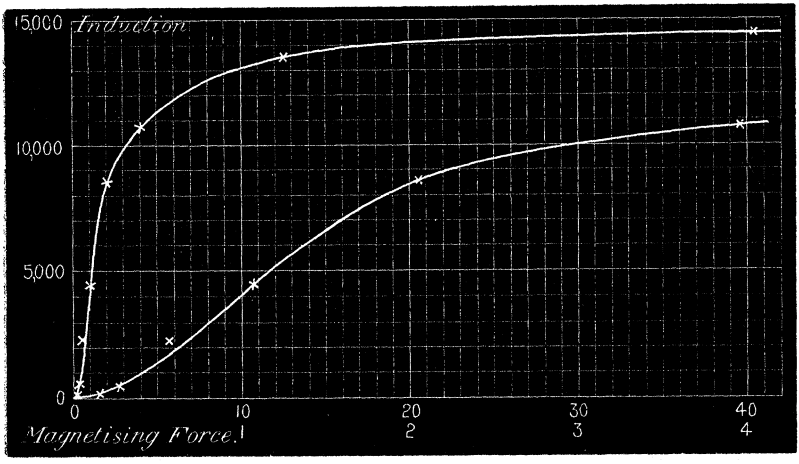
Fig. 3.



Secondary resistance = 2·91 ohms. Temperature, 727° C. (738°).

B.....	167	532	2260	4405	8553	10,763	13,580	14,442
H.....	0·15	0·28	0·56	1·08	2·05	3·97	12·62	40·4

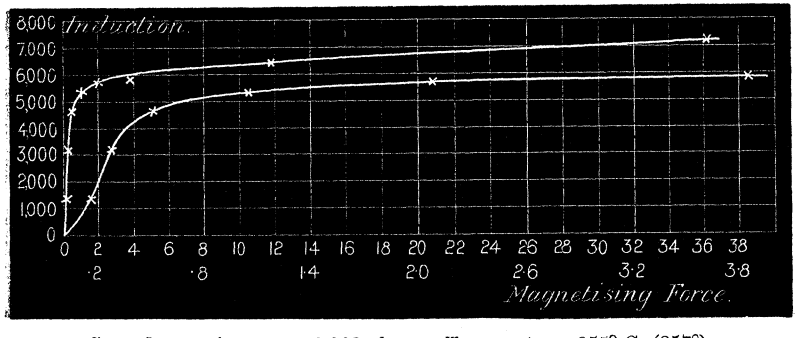
FIG. 4.



Secondary resistance = 3·046 ohms. Temperature, 770° (780°).

B.....	249	1030	2971	6441	8944	10,727	12,528	13,139
H.....	0·14	0·28	0·56	1·07	2·08	3·87	12·6	39·7

FIG. 5.



Secondary resistance = 3·303 ohms. Temperature, 855° C. (857°).

B.....	1316	3123	4682	5347	5779	5902	6513	7139
H.....	0·15	0·28	0·53	1·05	2·08	3·87	11·9	36·1

In these we see for a rise of temperature a marked decrease of hysteresis and a very much lower maximum of induction.

Also that for a small magnetising force the permeability rises very remarkably with the temperature, but just the reverse for a force of, say, "40."

FIG. 6.

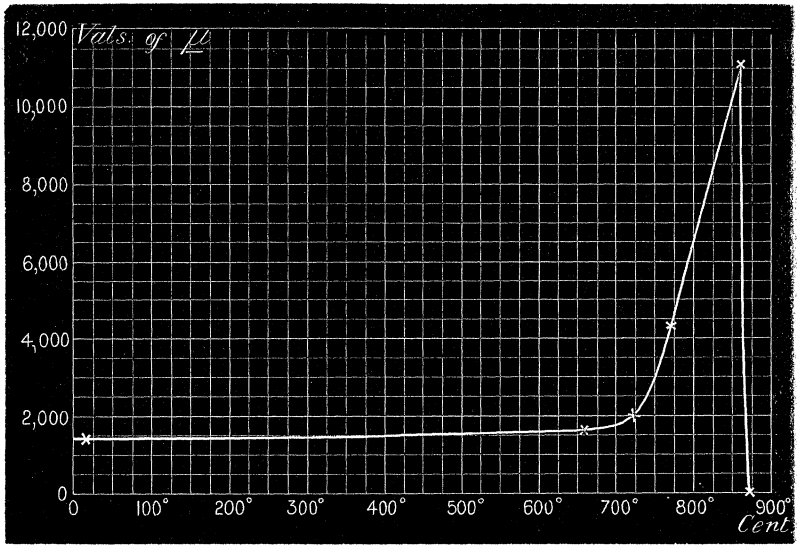


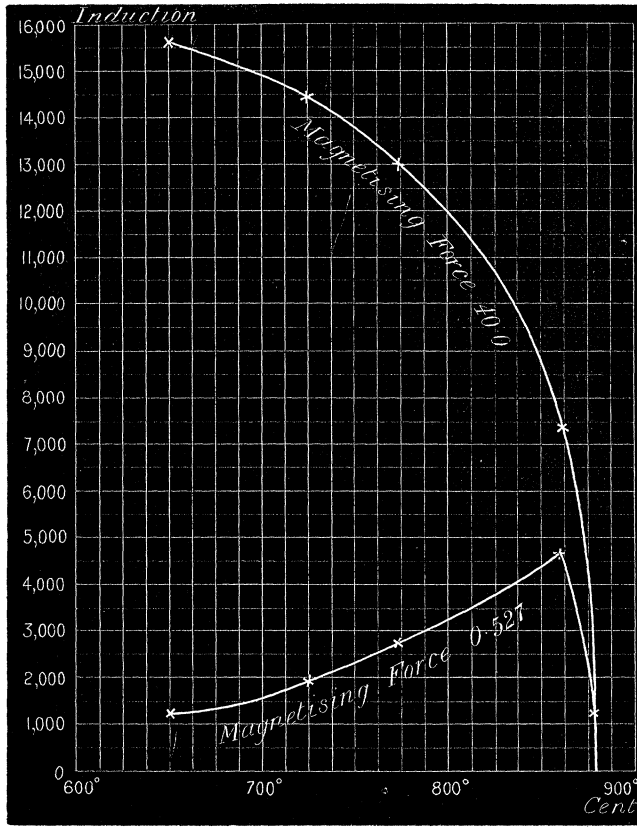
Fig. 6 shows the rise of permeability in relation to temperature when H = 0·3, the maximum permeability observed being 11,100 for a magnetising force of 0·3, and at a temperature of 855° C. (857°).

Fig. 7 contrasts the relation of induction to temperature at a small and a larger magnetising force.

During the heating of the specimen, the critical point, when the iron suddenly became non-magnetic, was reached at 874° C. (875°), and on cooling it became magnetic at 835° C. (838°).

Comparing these results with those obtained with the more ordinary specimens of iron mentioned in Dr. Hopkinson's paper, we have here 874° C. as against 786° C., while in an experiment on some soft iron wire the critical temperature was 880° C., and for hard pianoforte wire it was 838° C.

Fig. 7.



"On the Shoulder Girdle in Ichthyosauria and Sauropterygia." By J. W. Hulke, F.R.S. Received April 11,—Read May 12, 1892.

In a paper recently communicated to the Royal Society by Professor H. G. Seeley,* in which is discussed "The Nature of the Shoulder Girdle and Clavicular Arch in Sauropterygia," the author challenges the validity of statements relating to this girdle made by me at the Anniversary Meeting of the Geological Society of London in 1883.† This from so eminent a palæoherpetologist imposed on

* Seeley, Professor H. G., "The Nature of the Shoulder Girdle and the Clavicular Arch in Sauropterygia." Received January 18, 1892. Read February 18, 1892. 'Proc. Roy. Soc.'

† Hulke, J. W., "Presidential Annual Address," 'Geol. Soc., Lond.,' on Feb. 16, 1883; 'Quart. Jl. Geol. Soc.,' vol. 39, 1883, Proc., p. 38.

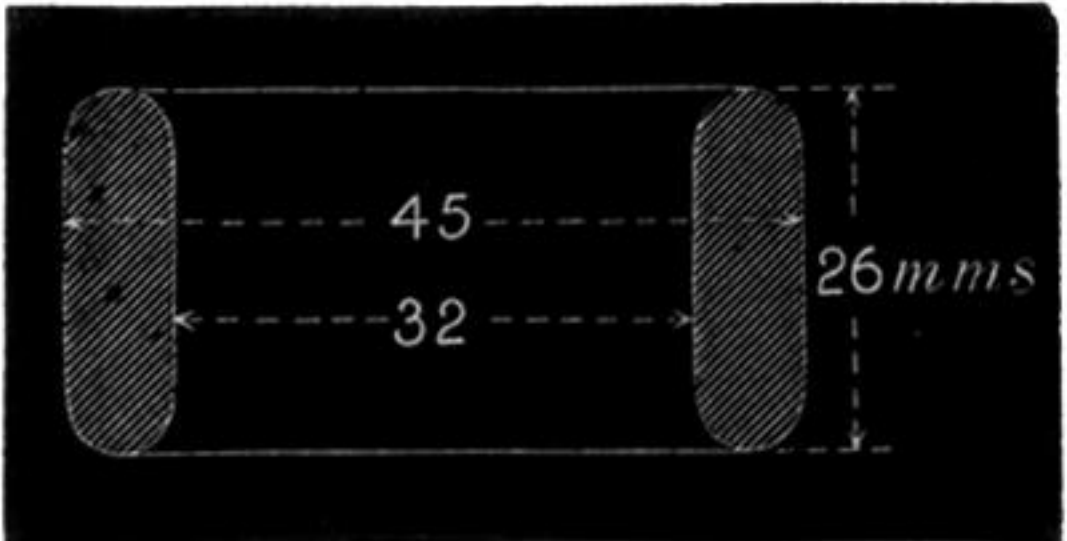

45
32
26 mms

FIG. 1.

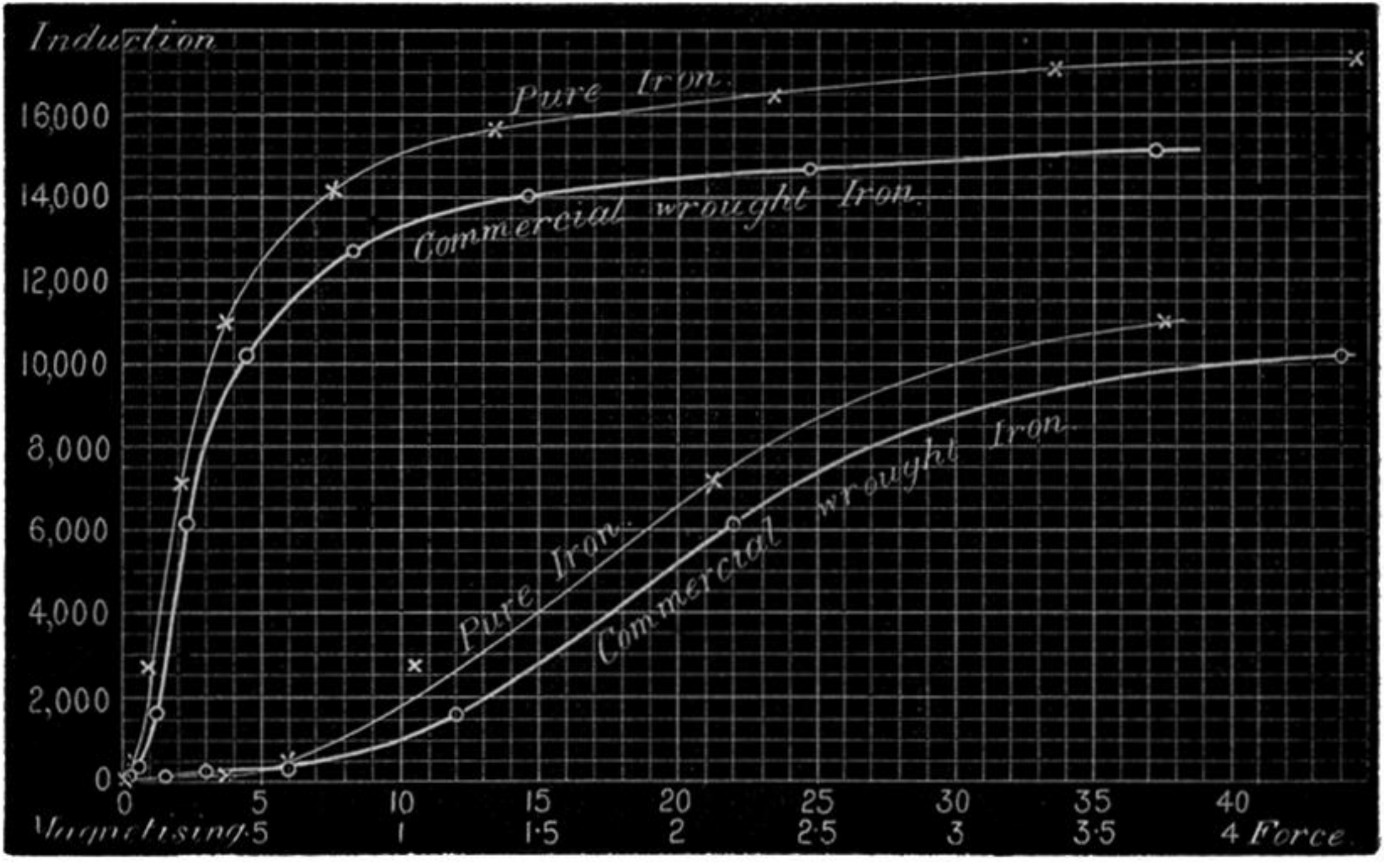

Induction
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Pure Iron.
Commercial wrought Iron.
Pure Iron.
Commercial wrought Iron.
0
5
10
15
20
25
30
35
40
Magnetising Force
·5
1
1·5
2
2·5
3
3·5
4

FIG. 2.

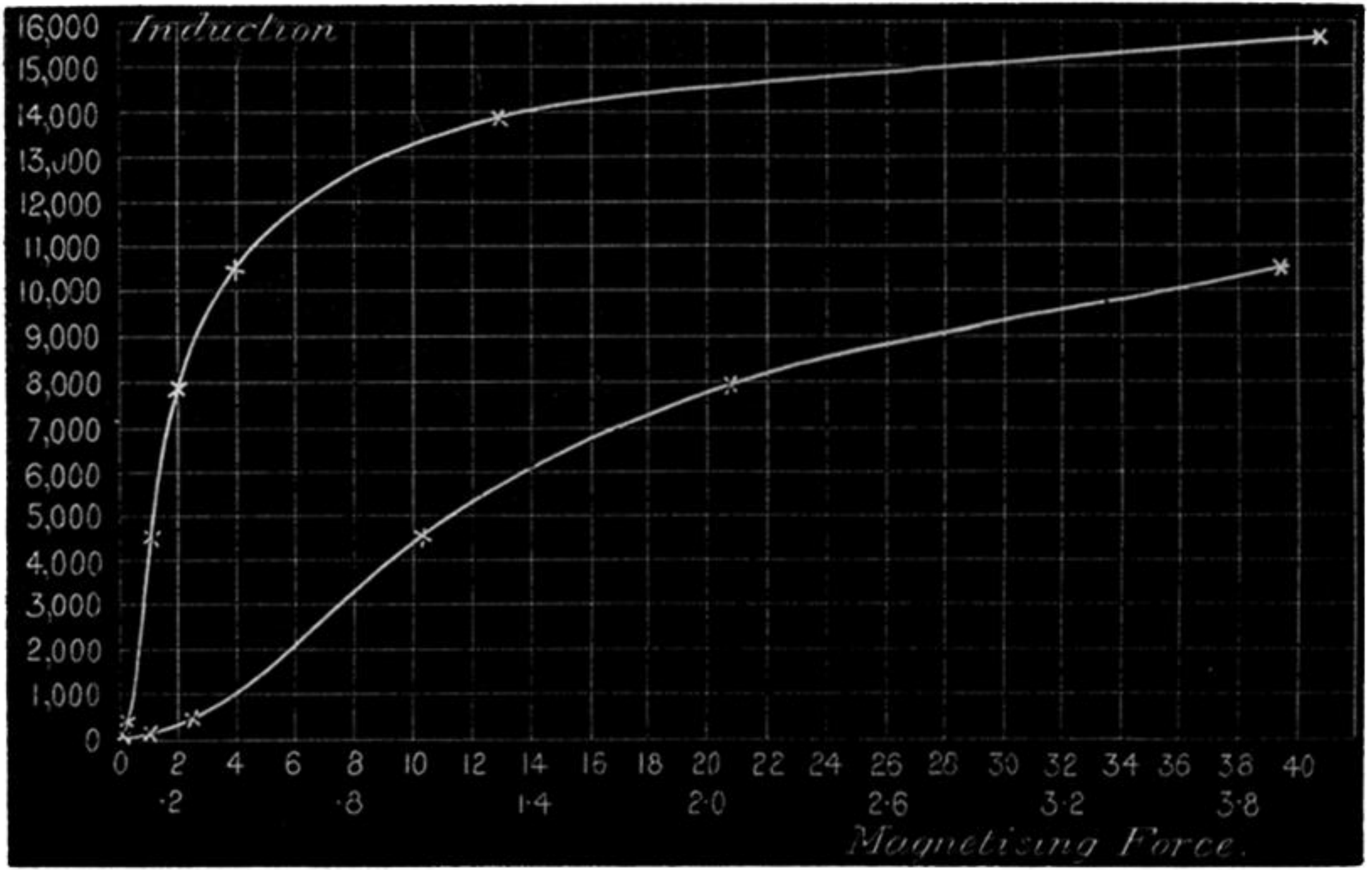

Induction
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
·2
·8
1·4
2·0
2·6
3·2
3·8
Magnetising Force.

FIG. 3.

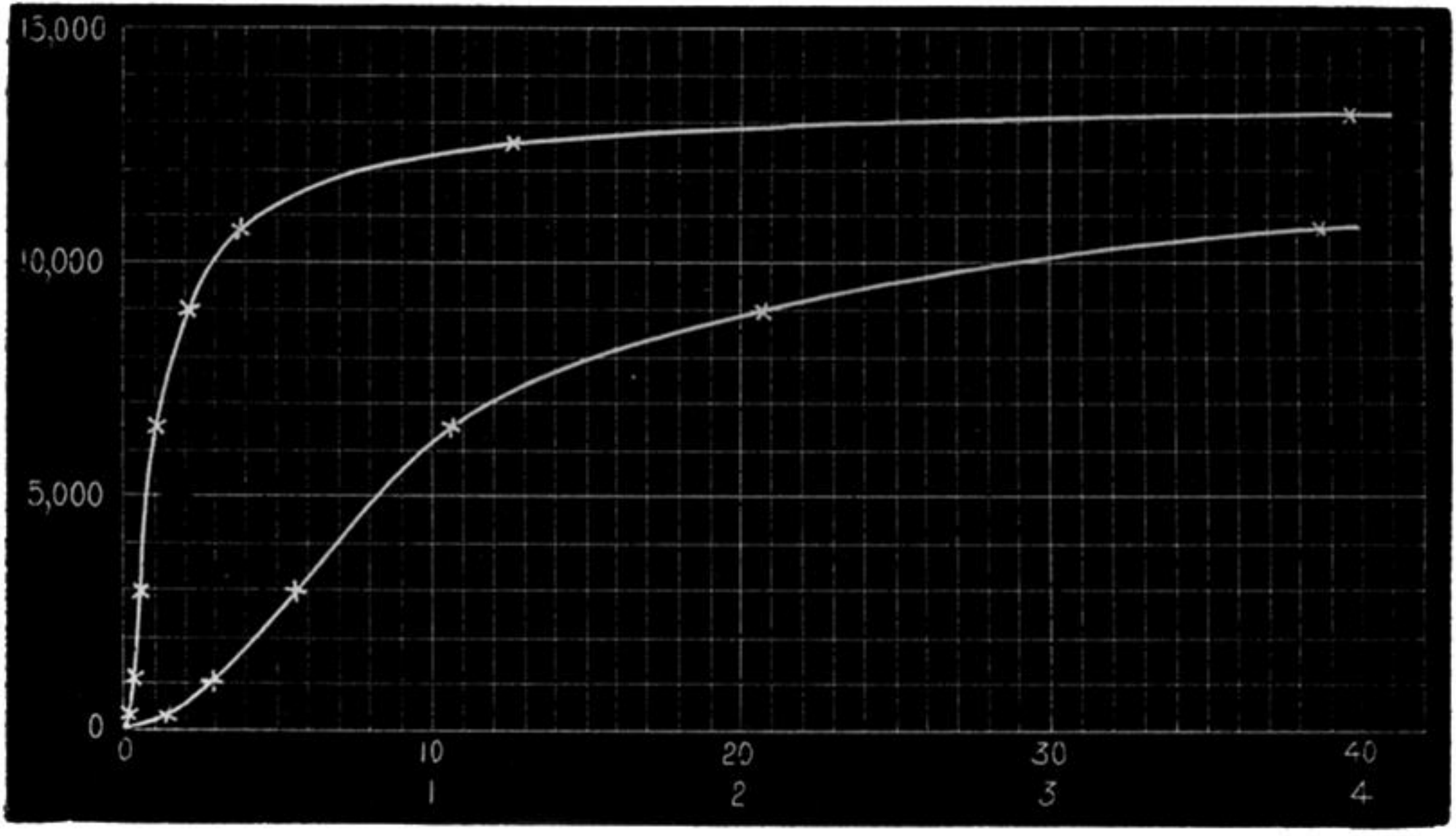


FIG. 4.

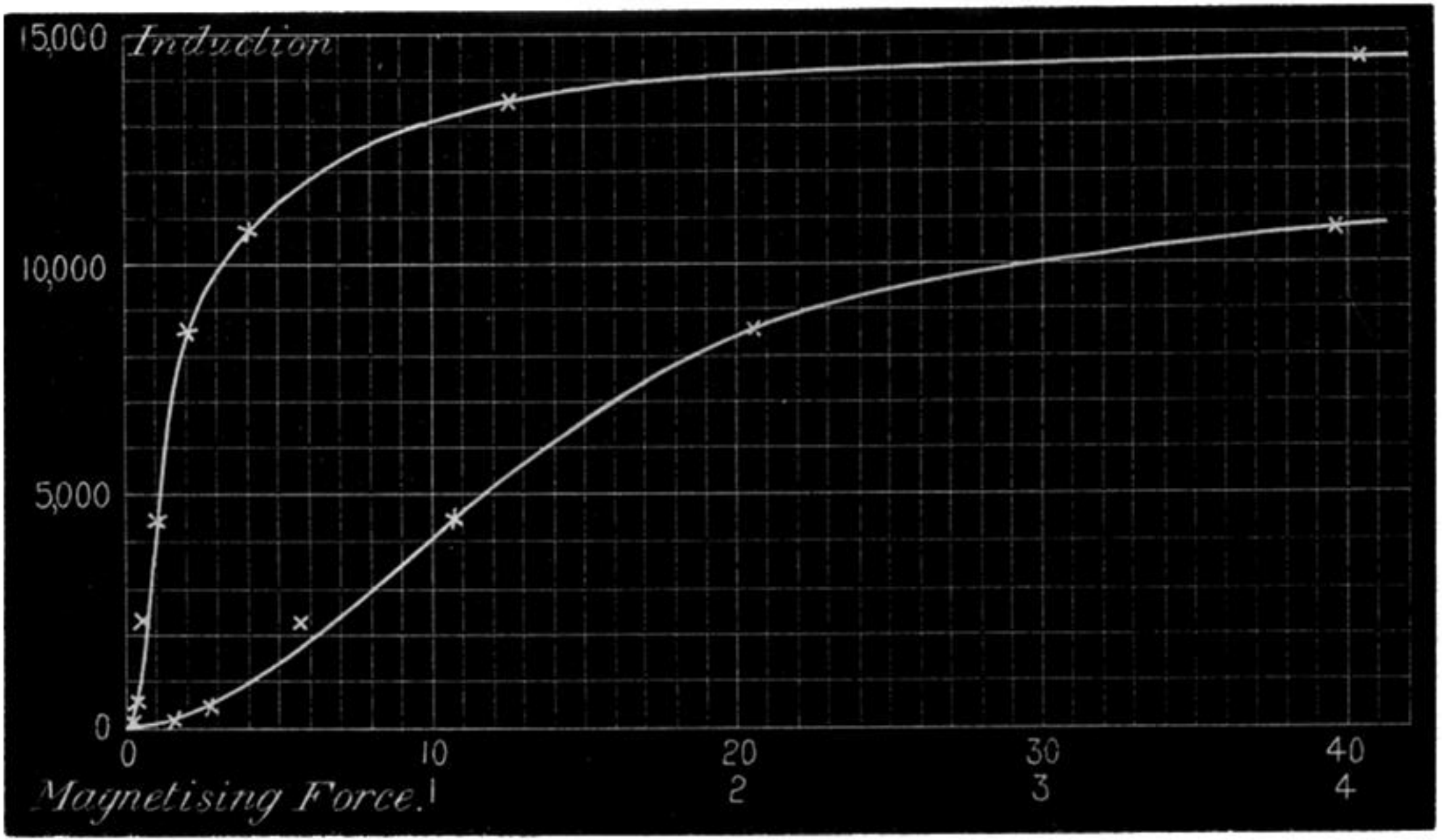

15,000
Induction
10,000
5,000
0
0
10
20
30
40
Magnetising Force.
1
2
3
4

FIG. 5.

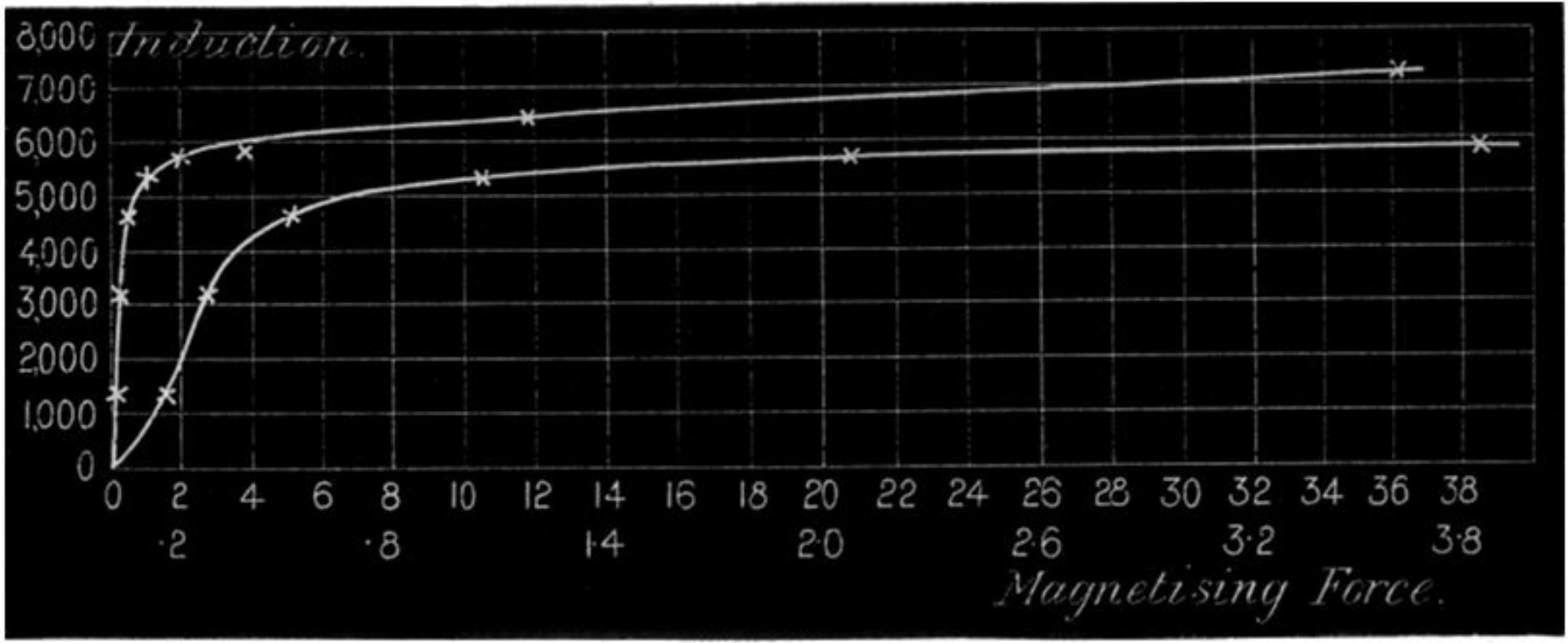

Induction.
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
·2 ·8 1·4 2·0 2·6 3·2 3·8
Magnetising Force.

FIG. 6.

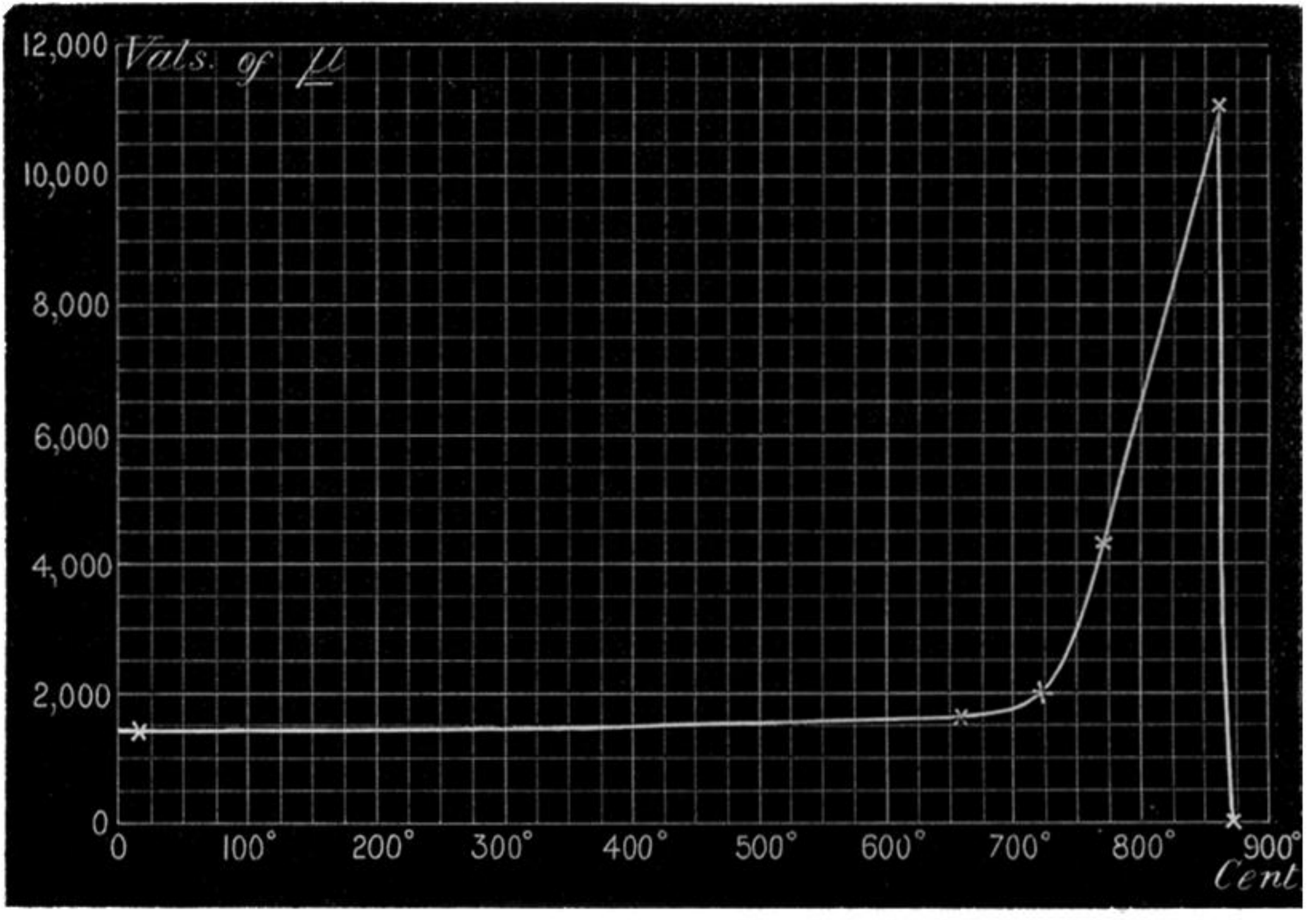
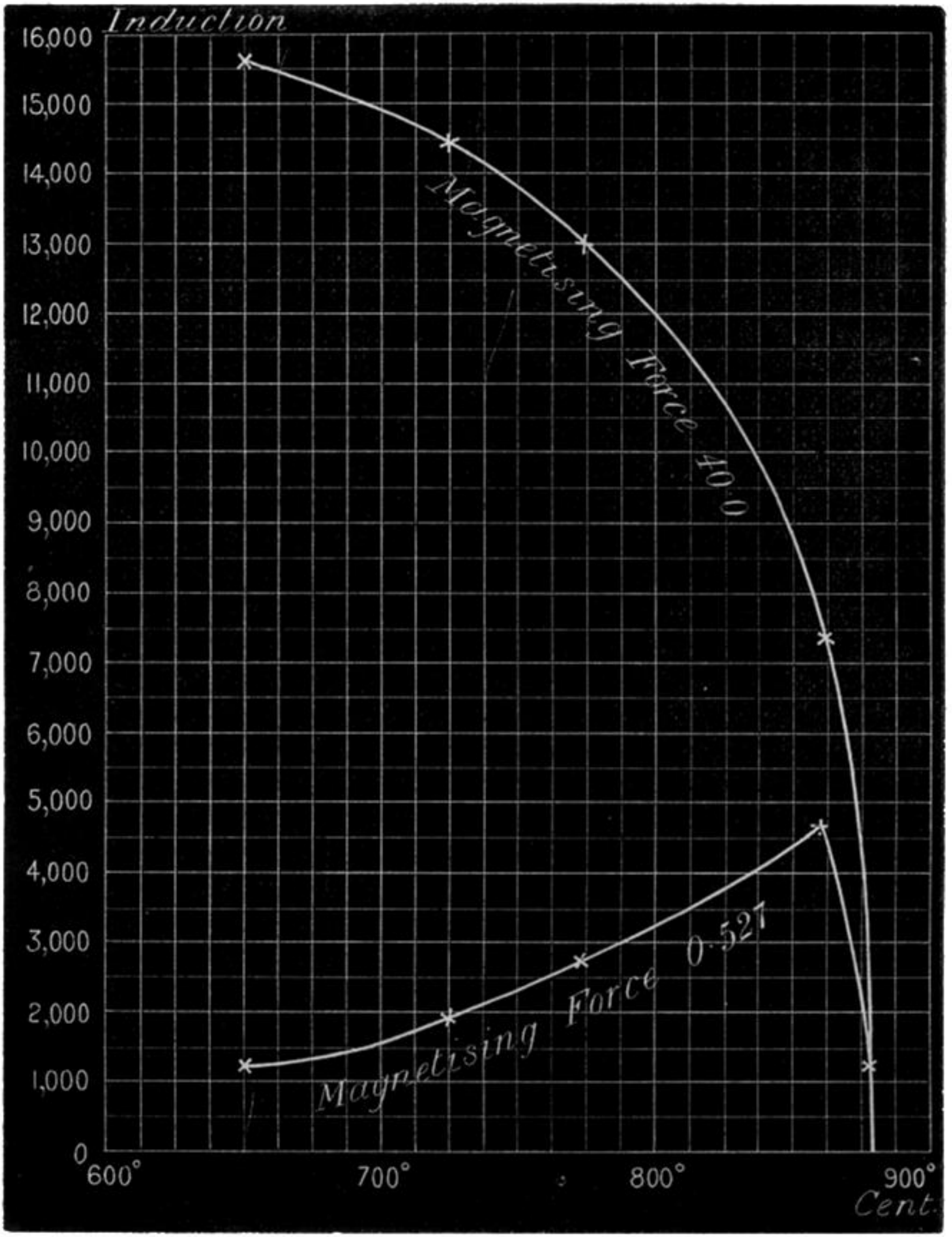

12,000
Vals. of μ
10,000
8,000
6,000
4,000
2,000
0
0
100°
200°
300°
400°
500°
600°
700°
800°
900°
Cent

FIG. 7.


Induction
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Magnetising Force 40·0
Magnetising Force 0·527
600°
700°
800°
900°
Cent.